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FINAL DESIGN DOCUMENTATION

FOR THE

WARTIME PERSONNEL ASSESSSMENT MODEL

(WARPAM)

(VERSION 1.0)

25 March 1991

Prepared for:

TRADOC ANALYSIS COMMAND
Building 401B
Fort Benjamin Harrison, Indiana 46216-5000

Contract Number MDA903-88-D-1000
Task Order 0037

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188. Exp. Date: Jun 30, 1986

1a. REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS: None
2a. SECURITY CLASSIFICATION AUTHORITY: N/A	3. DISTRIBUTION/AVAILABILITY OF REPORT: Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE: N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): SAIC-90/1459	5. MONITORING ORGANIZATION REPORT NUMBER(S): To be assigned
6a. NAME OF PERFORMING ORGANIZATION: Science Applications International Corporation; 6b. OFFICE SYMBOL (If applicable): N/A	7a. NAME OF MONITORING ORGANIZATION: TRADOC Analysis Command-FT Benjamin Harrison
6c. ADDRESS (City, State, and ZIP Code): 1710 Goodridge Drive, T1-7-2, McLean, VA 22102	7b. ADDRESS (City, State, and ZIP Code): ATTN: ATRC-B (BLDG 401-B), Fort Benjamin Harrison, IN 46216-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: TRAC-FBHN; 8b. OFFICE SYMBOL (If applicable):	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: MDA903-88-D-1000
8c. ADDRESS (City, State, and ZIP Code): ATTN: ATRC-B (BLDG 401B), Fort Benjamin Harrison, IN 46216-5000	10. SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO.; PROJECT NO.; TASK NO. 0037; WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

Wartime Personnel Assessment Model (WARPAM)

12. PERSONAL AUTHOR(S)

James A. Wojcik, John A. Tenshaw, Beth A. White

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Descriptive Documentation	FROM 6/30/89 TO 8/31/90	1991 March 25	29

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Personnel Replacements, Return-to-duty Personnel, CONUS Replacement Center, Replacement Battalion, Reclassification.

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Wartime Personnel Assessment Model (WARPAM) is a skeletal model, designed for operation on a Sun workstation, links the outputs from several Army models and then through a series of simulations produces a comprehensive depiction of the Army wartime personnel replacement system. Specifically, WARPAM provides the capability to: forecast the personnel system's potential to satisfy projected requirements, link doctrinal concepts with output from current "stand alone" Army models, simulate the reclassification of return-to-duty personnel generate logistical needs to support the personnel system and perform "What if" analysis regarding force structure or doctrinal changes. These capabilities enable TRAC-FBHN to provide quantitative input to the Army's macro-level decision-making process in regards to analyzing and evaluating force structure and personnel replacement doctrine and also satisfy the Army's requirements for micro-level modeling of replacement center activities.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION: Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL: MAJ James Thomas	22b. TELEPHONE (Include Area Code): (317)543-6883; 22c. OFFICE SYMBOL:

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

SPECIAL TECHNICAL NOTICE

This paper is an unofficial document intended for wide distribution to obtain comments. The development of the Wartime Personnel Assessment Model (WARPAM) and its supporting documention was completed by the Science Applications International Corporation (SAIC) under contract number MDA903-88-D-1000. Major James R. Thomas of TRADOC Analysis Command - Ft. Ben Harrison was the Technical Representative responsible for the monitoring of this effort.

SAIC also performed an application with WARPAM in a partial mobilization scenario for the Department of the Army Deputy Chief of Staff for Personnel. An Executive Summary of the approach used in this application and its findings are included at the end of this report. This page is the only other addition made by the TRADOC Analysis Command - Ft. Ben Harrison in sending this paper into publication.

Also included as part of the contract deliverables for the WARPAM is a Programmer's Manual and a User's Manual. These manuals contain all source code and specific instructions used in developing and operating WARPAM. These manuals are located at TRAC - Ft. Harrison.

The views, opinions, and/or findings contained herein are those of the authors and should not be construed as the official position of the TRADOC Analysis Command, US Army Training and Doctrine Command, or an official Department of the Army position, policy, or decision unless so designated by other official documentation.

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SECTION PAGE

ANNEXES

SECTION 1
GENERAL

1.1 PROJECT PURPOSE

The purpose of this project is to develop a skeletal computer model for TRAC-FBHN which simulates the flow of personnel through the wartime personnel replacement system. Designed for operation on a Sun workstation, the model links the requirements and personnel assets generated from several Army models and then through a series of computer simulations generates a comprehensive assessment of the capability of the Army personnel system to provide replacements to multiple theaters during wartime. Specifically, The Wartime Personnel Assessment Model (WARPAM) performs a micro-level simulation of reclassification of theater return-to-duty personnel and flow of individual replacements through multiple CONUS and OCONUS replacement activities.

1.2 PRIMARY PROJECT REFERENCES

The primary references upon which WARPAM is designed are listed below.

- Wartime Personnel Assessment Model (WARPAM), Government Statement of Work, April 1989 (Reproduced in its entirety at Annex A).
- Personnel Service Support (PSS) in Army Models (Draft), TRADOC Analysis Command - Fort Benjamin Harrison, Major James Thomas, 1989.
- Wartime Replacement System Study (WRSS), Soldier Support Center, Fort Benjamin Harrison, March 1987.
- FM 12-6, Personnel Doctrine (Final Coordinating Draft), HQ, Department of the Army, August 1988.
- FM 12-6, Personnel Doctrine (Final Approved Draft), HQ, Department of the Army, June 1989.
- TOE Number 12406L0, HHD, Personnel Replacement Battalion, HQ, Department of the Army, October 1987.
- TOE Number 12407L0, Replacement Company, HQ, Department of the Army, October 1987.
- ARTEP Number 12-406-01-MTP, Personnel Replacement Battalion (GS/DS) (Coordinating Draft), HQ, Department of the Army, undated.
- ARTEP Number 12-407-30-MTP, Replacement Company (GS/DS), HQ, Department of the Army, July 1989.

- ARTEP Number 12-406-02-MTP, Personnel Replacement Battalion/Company (CRC) (Draft), HQ, Department of the Army, undated.

1.3 TERMS AND ABBREVIATIONS

Annex B contains a listing of terms, definitions, and acronyms unique to the development of WARPAM and subject to interpretation by the user of this document. This listing does not include data item names or codes, which are discussed as appropriate within the body of the document.

SECTION 2
REQUIREMENTS

2.1 BACKGROUND

For the Army to perform effectively in time of war, the resources available must be effectively managed. This means that planning must be accomplished to ensure that the right resources are available at the right time and place. Part of this planning is for the utilization of replacement personnel. This planning requires insight into a number of personnel systems and processes including requirements estimation, mobilization and training, personnel classification and assignment policies and procedures, and the casualty estimation, processing, and return to duty process. The current Army Family of Models lacks a model linking the various stages of the replacement process and, hence, fails to represent the doctrinal force structure's inherent capabilities in satisfying the required flow of wartime replacements.

The Army's doctrinal wartime replacement system is a multi-echelon system with the mission of coordinating the support and delivery of replacements and return-to-duty soldiers to units operating in one or more theaters to satisfy fluctuating personnel replacement requirements. Key functions in this process include: personnel accounting and processing, MOS reclassification as necessary, determination of assignments, and the coordination of logistics and transportation support. Each of these functions, to some degree, must be accomplished at each echelon of the system. Similarly, each of these functions must be modeled in order to predict the operation of the system and the ability of the system to accurately satisfy replacement requirements in a timely manner.

Complicating the modeling efforts are a number of currently unsolved problems. One of the most significant of these is the fact that the current methodology for estimating Return-to-Duty (RTD) personnel, which are estimated to comprise 40-50% of all replacements in the first 90 days of warfare, assumes that within each category the distribution of patient conditions is equal and, as a result, RTD per category have the same probability of recovery. Furthermore, the methodology assumes that remaining physical disabilities never limit the reassignment of the returning soldier. Both of these assumptions are believed to be inaccurate and misleading. This problem, and others, must be solved if the replacement process is to be modeled accurately.

2.2 CURRENT SYSTEM

Current computer simulations of theater combat define casualties in terms of combat or noncombat. There are no provisions during, or after, the simulation to consider the effect that the patient reclassifications have on the personnel system's ability to provide the right man to the right job at the right time. The Concepts Analysis Agency (CAA) uses the historically based Patient Flow Model

(PFM) to estimate from the gross quantities of casualties generated by combat simulations, their probable dispositions; RTD, evacuated, died in hospital, and patient length of hospital stay. CAA uses the PFM in conjunction with other models to support the Army Wartime Manpower Planning System (WARMAPS). The Department of the Army is required to submit annually, in conjunction with the Program Objective Memorandum (POM), military manpower data for WARMAPS. This data depicts time-phased personnel requirements, supply, and shortfalls for a specific theater within the Defense Guidance (DG) scenario. It should be apparent that the problems attributable to inaccurately portraying the personnel replacement system impact on decision making at the highest levels in the DoD.

2.3 SYSTEM REQUIREMENTS

The WARPAM system is designed to provide: (1) a representation of the key doctrinal "links" in the personnel replacement system; (2) the ability to model replacements by grade, MOS, gender, physical profile, and service; (3) a stand alone capability to model the reclassification of RTD based upon inputs from combat simulations, patient condition classifications, medical treatment system capabilities, results of expert opinion regarding the PULHES profile distribution for the patient conditions, and the personnel system's resultant utilization based upon the reclassification; and, (4) the ability to generate requirements for the logistical system to support replacement operations, including individual equipment items (i.e., NBC equipment, individual weapon) and transportation assets.

2.3.1 PURPOSE

WARPAM resolves many of the US Army's modeling shortcomings associated with representing the flow of qualified replacements to the Airland Battlefield. Specifically, WARPAM provides the capability to: forecast the personnel system's potential to satisfy projected requirements, link doctrinal concepts with output from current "stand alone" Army models, simulate the reclassification of return-to-duty personnel, generate logistical and equipment requirements to support the personnel system, and perform "what if" analysis in regards to force structure or doctrinal changes. These capabilities enable TRAC-FBHN to provide quantitative input to the Army's macro-level decision-making process in regards to analyzing and evaluating force structure and personnel replacement doctrine. Secondly, it satisfies the Army's requirements for micro-level modeling of replacement center activities enabling the analysis of contemplated changes prior to implementation. WARPAM provides the following functions:

- Comparison of requirements generated by other Army personnel mobilization models
- Evaluation of the effects of proposed reclassification policy on replacement flow operations

- Micro-level modeling of replacement activity operations to include force structure evaluation and personnel policy
- What-If modeling of personnel policy and force structure with rapid response times
- Determination of transportation and support requirements
- Interface with other Army models to improve personnel modeling in the family of Army models
- Evaluation of the capability of active and reserve forces to support multiple theaters operations

2.3.2 SCOPE

After replacements arrive at the CONUS Replacement Centers (CRC), the model tracks replacements (including new replacements, CONUS and theater RTD, and administrative RTD) through the designated theater(s) and through the personnel system until delivery to the required unit. Statistics on percent fill by time, grade, MOS, the number of combat MOS RTD after reclassification, and the total number of personnel replacements processed by the system are macro output parameters of the model. Micro-level outputs include the number of personnel: reclassified, processed through each CRC, transported, and processed through the OCONUS replacement center.

Due to the scope of this model and the monetary limitations of this project, the government provided the data bases required to run the model. In cases where data was not readily available, expert estimates where utilized and are fully documented. As the focus of the contractual effort was to develop a skeletal model which over time could be augmented with more accurate data, a plan for future studies or simulations to support this effort was a requirement of the contract.

2.3.3 CONTEXT

Replacement operations encompass the coordination of all activities required to deliver individual and small-unit replacements, as well as return-to-duty soldiers, from CONUS CRC through the OCONUS Replacement activity to their eventual units of assignment in theaters.

2.3.4 OPERATIONAL CONCEPT

WARPAM is design to be operated by TRAC-FBHN on a Sun 4 workstation. The complete series of modules and models may be run or any single model may be run with the data produced from previous runs. Operation of the complete system involves running the following modules and models in sequence: the preprocessor with four conversion programs to input files from Army models with assets and

requirements and the requirement/asset generator which compiles these files into a common data base, the Reclassification Model to generate theater RTD, the CRC model to simulate flow through a CONUS or OCONUS replacement facility, the Transportation Model to compare flows through matching CONUS and OCONUS facilities, and a report generator module which allows the user to manipulate the output data. This system is depicted in Figure 1.

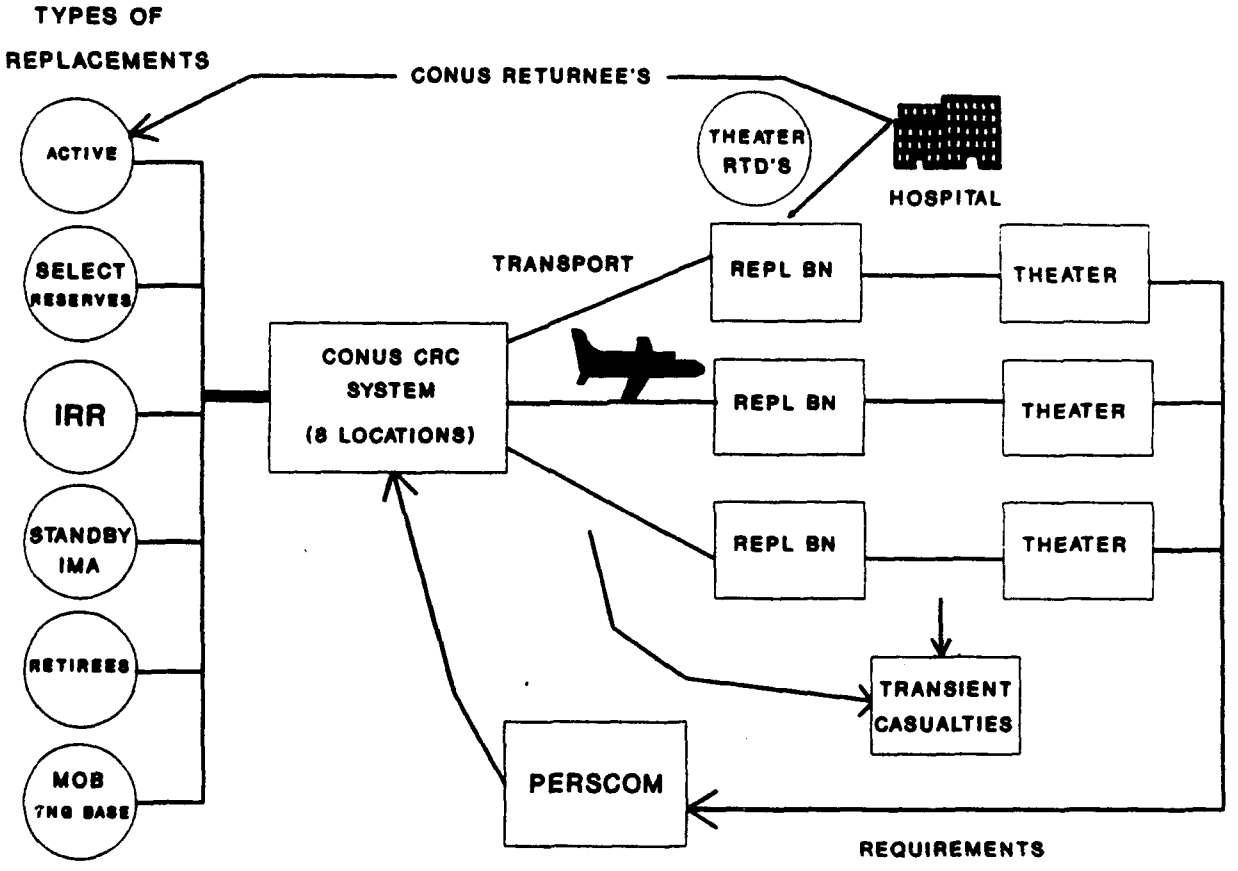

FIGURE 1: WARTIME PERSONNEL REPLACEMENT SYSTEM

The preprocessor module of WARPAM need only be updated when new input files are furnished. The time periods between these updates may vary as the Army models which provide the requirements and assets data are revised on different

time cycles. In general, at least one file will have to be updated every six months. When a new input file is received, the appropriate conversion program must be run to bring this file into standard WARPAM format and the requirements/ assets generator program rerun to bring this new file into the main data base for use in the operational models.

If the user is satisfied with the input files, the reclassification model or the CRC model may be directly accessed. After at least one CRC and replacement battalion model have been run, the user also has the option of directly entering the Transportation Model to compare the flow through the CRC and individual replacement battalion.

Output reports created in the preprocessor and each operational model are translated to DOS file for conversion to DBASE III plus files. The conversion from UNIX to DOS files is accomplished automatically by the TRAC-FBHN LAN software. The conversion to DBASE III files is accomplished by DBASE III conversion programs. Once converted to DBASE files, the user may scan or create reports from the standard report formats provided.

2.3.5 PRIMARY FUNCTIONS

The primary functions of WARPAM are the preparation of data from other Army models in a preprocessor phase, the reclassification of theater return-to-duty personnel, the time-phased processing of personnel through the replacement system, and the comparison of CONUS and OCONUS replacement activities.

2.3.6 CONSTRAINTS

Based on the scope of the project, development of the WARPAM system was built with the following constraints.

- Requirements and assets were to be extracted from currently accepted Army mobilization models
- The system had to be functional on the available TRAC-FBHN hardware

2.4 DELIVERABLE ITEMS

- Fully functioning WARPAM model on TRAC-FBHN hardware
- WARPAM Version 1.0 Description Document (Final Report)
- WARPAM Version 1.0 Source Code
- WARPAM User's Manual
- WARPAM Programmer's Manual

SECTION 3
ENVIRONMENT

3.1 EQUIPMENT ENVIRONMENT

WARPAM is designed to operate on the TRAC-FBHN SUN 4/110-FCE-8 workstation with the following major components:

- 16" color monitor
- 32 MB memory
- 327 MB hard disk
- 60 MB 1/4" tape cartridge drive (Low density)
- Ethernet link to 5 1/4" diskette drive

3.2 SUPPORT SOFTWARE

All programs are heavily commented to afford ease of programming and maintenance. WARPAM utilizes the following software for the programs indicated:

- SUN system "C" programming language: Executive Program
- FORTRAN 77: All programs except those written in SLAM II
- SLAM II: CRC Model to replicate the internal operation of a replacement unit

3.3 INTERFACES

Two types of interfaces are necessary for WARPAM, an interface with other Army models to acquire data and, secondly, the internal interfaces between modules. The interface with other models is through standard ASCII data files. The transfer medium is either 5 1/4" diskettes or 9 track, 1/2" magnetic tapes. Since the data provided is not in a format directly usable to WARPAM, a data preprocessor has been written to read the tapes, extract the necessary information, and write it out in the desired format. The second type of interface is the internal WARPAM interface between the files produced by the preprocessor or the operational models and the module/model currently in operation. These are discussed in detail in the descriptions of the operational models.

3.4 SECURITY

The data bases and tables used in developing the initial version of WARPAM are not classified. Other variations of these data bases (disaggregated to theater level) may be classified and care should be exercised when operating in the classified mode. Special precautions should be taken when the system is operated, as designed, in the TRAC-FBHN local area network configuration.

SECTION 4
SYSTEM DESIGN

4.1 SYSTEM DESCRIPTION

The primary functions of WARPAM are:

- Preparation of data from other Army models in a preprocessor
- Reclassification of theater return-to-duty personnel
- Time-phased processing of personnel through the replacement system
- Comparison of CONUS and OCONUS replacement activity capabilities

As there are several different requirement bases currently in use by the US Army, WARPAM was designed to allow the user to select the data base appropriate for the task. All assets are extracted from MOBMAN, except the projected skill level one training base output which is drawn from MOBARPRINT. The rationale for the selection of data is discussed in Section 4, below. These functions are performed in the preprocessor module, three operational models and the report generator which are depicted in Figure 2, below.

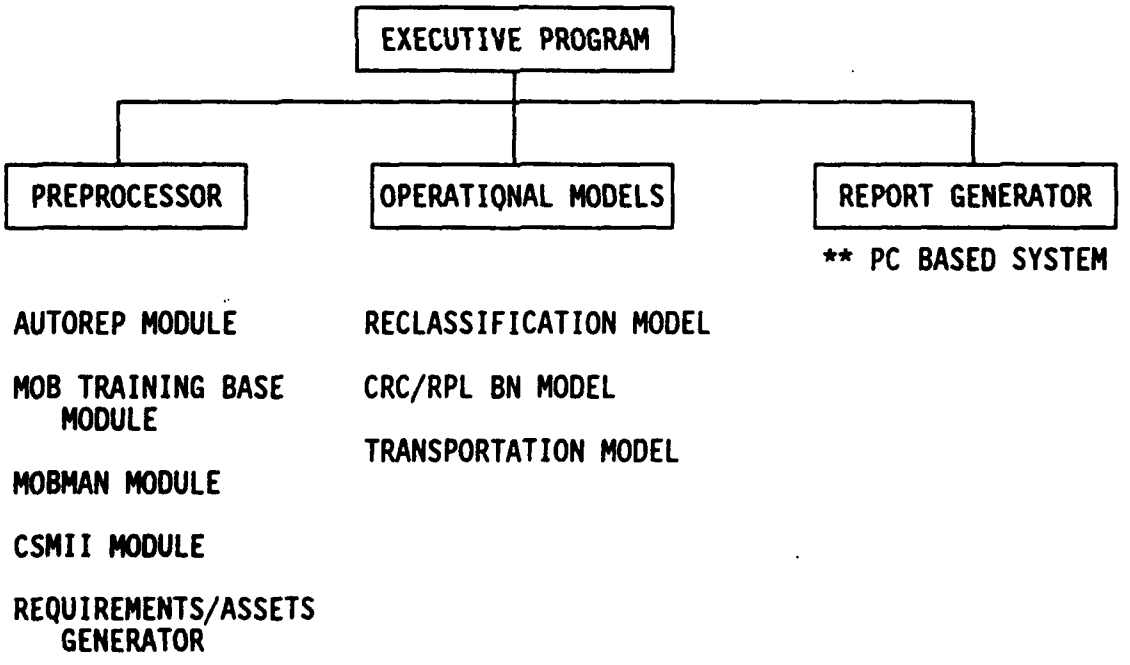

FIGURE 2: WARPAM OPERATIONAL ARCHITECTURE

WARPAM is programmed in FORTRAN 77, except for the CRC model which is programmed in a combination FORTRAN AND SLAM II, and the executive program which utilizes the resident Sun C-language. Detailed descriptions of each module are provided in Section 5, below.

4.2 GENERAL OPERATING METHODOLOGY

WARPAM is designed to allow the user to select operation of the full system or to enter directly into a specific model and utilize data currently in the system. The modular architecture of WARPAM is depicted in Figure 3. Procedures for initiating the system and entering the selected programs is described in the User's Manual, Section 3. Input modules are only run when new input files become available. As a general rule, this occur about every six months. Otherwise, the three operational models may be run without updating the assets and requirement file.

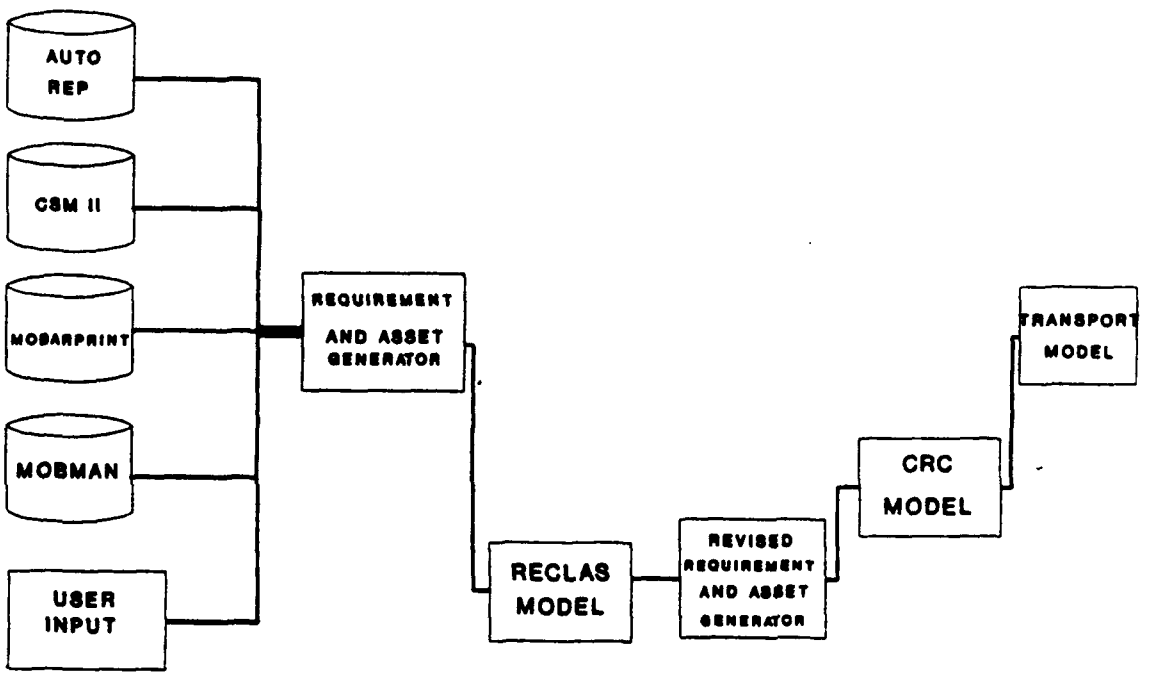

FIGURE 3: WARPAM ARCHITECTURE

4.3 SYSTEM INPUTS

WARPAM requires four files which are generated from current Army personnel models to furnish mobilization asset and theater requirement data. Additional input is provided by the user through the use of lookup tables which translate Army personnel policy into formats usable by WARPAM models.

4.3.1 AUTOREP

SOURCE — USA PERSCOM "Shelf Requisition" files
USA PERSCOM, Mobilization Division
CWO Gray Tele: 325-1979

DESCRIPTION — Individual theater requirements developed with CINC input at the ALO 2 level. Currently available for Europe and Korea.

MEDIA — 5 1/4 floppy disk (10 low density disks)

LANGUAGE — DBASE III Plus

USE — Provides the requirement files used by U.S. Army PERSCOM and HQDA. Currently limited to single theater OPLANS.

4.3.2 MOBMAN

SOURCE — HQDA MOBMAN Model
USA PERSCOM Mobilization Division
Mr. Mark Seegar Tele: 325-3883

DESCRIPTION — Multiple theater requirements consolidated to a single data base at the ALO 1 level. These requirements are based on SECDEF guidance.

MEDIA — 1/2" magnetic tape. This file is approximately 8 MB and requires the magnetic tape be downloaded on a mainframe to a 1/4" Sun cartridge.

LANGUAGE — ASCII (must be requested from contractor)

USE — Provides the requirement file for studies compatible with Secretary of Defense requirements (multiple theater) and all assets data except Skill Level One (enlisted). Single theater files are classified.

4.3.3 CASUALTY STRATIFICATION MODEL II (CSM II)

SOURCE — USA Soldier Support Center

DESCRIPTION — Individually developed casualty model with requirements at the theater or below level.

MEDIA — 5 1/4" floppy disk (one disk)

LANGUAGE — ASCII developed from a DBASE III file

USE — Provides requirement files based on user defined requirements at the battle and non-battle casualty levels. This file provides TRAC-FBHN total flexibility in creating a requirements file.

4.3.4 MOBARPRINT

SOURCE — HQDA, ODCSPER (DAPE-MPT)
Ms. Linda Pendelton Tele: 697-0781

DESCRIPTION — Enlisted skill level one output from a constrained training base environment.

MEDIA — 5 1/4 floppy disk (one disk)

LANGUAGE — ASCII

USE — Provides the enlisted Skill Level One assets data for all models. This file was selected over the MOBMAN file as it is based on a constrained training base output.

4.4 SYSTEM OUTPUTS

The skeletal design of WARPAM results in output files and reports generated by individual modules and models as opposed to the total system. The general procedure for developing reports and reviewing files is discussed in the Report Generator Section (5.5), below, and in detail in the user's manual.

4.5 SYSTEM INTERFACES

Hardware interfaces are discussed in section 3.3. Software program interfaces involve both linking internal modules as well as the input of external files. These interfaces are discussed in detail in the individual modules.

4.6 MAJOR SUBSYSTEM DESIGN

WARPAM is designed to process data from other Army models in a preprocessor phase, project reclassification of theater return-to-duty personnel, time-phase process of personnel through the replacement system, and compare CONUS and OCONUS replacement activities. Based on TRAC-FBHN design criteria, the system is constructed with modules which can be easily upgraded or replaced without requiring reprogramming of the total system. The major sub-systems of WARPAM are the:

- Preprocessor
- Reclassification model
- CRC model
- Transportation model
- Report Generator

Although not considered a major subsystem, the executive program warrants a brief discussion. The program, written in the Sun resident C-language, is design to allow the user to move to the various programs using the Sun workstation mouse without the need to enter any commands. By entering the Sunview program, the user may select the WARPAM icon which prompts a menu to appear on the screen. The user may then select the desired program from this window by use of the mouse. The program is independent of and does not interface with other WARPAM modules and only requires the Sun C-language and Sunview programs be on the system.

SECTION 5
MAJOR SUBSYSTEMS

5.1 PREPROCESSOR

The Preprocessor is designed to convert the output files of current military personnel mobilization models to a standard format and consolidate these into a single data base. To accomplish this, the preprocessor has four modules to convert the data, and a requirements/assets generator module to merge these converted files into a single data base. This conversion process to a standard data base format includes the following steps:

- Conversion to an ASCII format (as required)
- Aggregation of occupational specialties into branch/grade groupings
- Prioritizion of branches
- Assignment of code numbers to each entry which represent the appropriate time period, branch priority, and requirement/asset designator

5.1.1 AUTOREP CONVERSION PROGRAM

PURPOSE — This module converts the shelf requisition files created by US ARMY PERSCOM to standard WARPAM format. Multiple files may be received from PERSCOM for different theaters. These files should be used when studies are produced for HQDA and USA PERSCOM.

DEPENDENCIES — This module use two look-up tables, the Branch table and the Time Period table to aggregate MOS to branches and convert the file time periods to standard WARPAM time periods.

INTERFACES — WARPAM is currently configured to translate the files for Europe and Korea only. Files from PERSCOM are received on 5 1/4" floppy disks and are loaded via network and PC. The output file links to the Requirements/Assets Generator.

PROCESSING — The total processing of the AUTOREP files encompasses first converting the DBASE III Plus files to ASCII files using a DBASE III conversion program and then reformatting the data into the standard WARPAM format using a FORTRAN program. The DBASE conversion is accomplished on an IBM compatible PC, whereas the format conversion is accomplished on the Sun workstation. The FORTRAN program which converts the data essentially reads in the data and then recompiles it in a new array by branch and time period. The program automatically

runs two sub-programs which convert the officer and enlisted files and combine these into a single output file. Requirements created by this module are labeled as theater requirements AE1 for Europe and AKO for Korea.

DATA — All data required for this module are contained in the AUTOREP file received from USA PERSCOM. Two input files are received, one for officers and one for enlisted.

5.1.2 MOBMAN CONVERSION PROGRAM

PURPOSE — This module converts the MOBMAN model output developed for the Mobilization Directorate of PERSCOM to standard WARPAM format. This file should be used when performing DOD directed studies or any study based on SecDef guidance.

DEPENDENCIES — Requires the Branch look-up table.

INTERFACES — The new file is received on 1/2" tape in an ASCII format and must be converted by programmer personnel utilizing a mainframe. The output file from this module links to the Requirements/Assets Generator.

PROCESSING — The FORTRAN program which converts the data essentially reads in the data and then recompiles it into a new array by branch and time period. The module generates two output files. One file contains requirements based on Defense Guidance while the second files contains all assets used in WARPAM except enlisted skill level one personnel. MOBMAN generates both of these two output files with a single pass through the input data.

DATA — All required data are provided by the MOBMAN file.

5.1.3 CSM II CONVERSION PROGRAM

PURPOSE — This module converts the CSM II model output created by Soldiers Support Center to usable WARPAM configuration. As CSM II is operated by an office in the immediate vicinity of TRAC-FBHN and as the level of resolution of CSM II can be readily changed, CSM II can provide a collection of input files at varying levels of command for use in WARPAM.

DEPENDENCIES — Requires the Branch look-up table.

INTERFACES — The new file is received on 5 1/4" floppy disks. The file should be requested in ASCII format. The input files are loaded onto the Sun drive by way of the network and PC. The

output file from this module links to the Requirements/Assets Generator.

PROCESSING — The FORTRAN program which converts the data essentially reads in the data and then recompiles it in a new array by branch and time period. Conversion of this file results in the creation of two requirement files labeled, CSMT for the total casualty requirement, and CSMB for the battle-only casualty requirements.

DATA — All required data are provided by the CSM II files.

5.1.4 MOBARPRINT CONVERSION PROGRAM

PURPOSE — The MOBTNGBS (Mobilization Training Base) module converts the output file generated from the MOBARPRINT program produced for HQDA, ODCSPER to standard WARPAM format. This file provides the enlisted skill level one assets for the WARPAM system.

DEPENDENCIES — Requires the Branch look-up table.

INTERFACES — The incoming file is supplied by the support contractor on a single 5 1/4" low-density floppy disk in ASCII format. The output files from this module links to the Requirements/ Assets Generator.

PROCESSING — The FORTRAN program which converts the data essentially reads in the data and then recompiles it in a new array by branch and time period. The output from this conversion is an asset file of skill level one training base assets labeled as asset code "TRN".

DATA — All required data are provided by the CSM II files.

5.1.5 REQUIREMENTS/ASSETS GENERATOR PROGRAM

PURPOSE — This module merges the converted input files into a single data base, assigns branch priorities and a unique code number, and then sorts the file by this code number.

DEPENDENCIES — The module utilizes two look-up tables, the WARPAM Branch Priority table and the Theater/Replacement Type table for branch priorities and code number development.

INTERFACES — The output files from the four previous conversion programs are used as input files to this module. The output file, titled REQAST.TBL is the basis of all subsequent WARPAM modeling and can be viewed by using the REQAST DBASE program.

PROCESSING — The processing involves reading in the converted input files and writing these to a single file with all assets and requirements sorted by code (time period, branch priority, and requirement or asset priority).

DATA — All required data for this module are furnished by the preprocessor file conversion programs.

5.2 RECLASSIFICATION MODEL

PURPOSE — The Reclassification Model is designed to project the number of return-to-duty (RTD) personnel based on a percentage of the casualties (requirements) sustained within a theater during a time period. These RTD are reclassified into a number of new branches with return dates distributed over several later time periods to simulate the effects of hospitalization and reclassification actions. The model allows the user, through the control of various input variables and user created tables, to simulate current personnel policy or conduct "What If" analysis.

DEPENDENCIES — The model uses the REQAST.OUT file from the preprocessor, two reclassification look-up tables, one for officers and one for enlisted personnel and a reclassification delay table.

INTERFACES — The model utilizes the output file from the preprocessor and generates an output file titled MODRQAST.OUT which is used by the CRC model.

PROCESSING — Casualties (requirements) are redesignated as new branches specified in the officer and enlisted reclassification tables. This is accomplished by reading the requirements line from the REQAST.TBL for the specified requirement into the model. Then, through a series of calculations, the requirements are transformed into a reduced number of assets in new branches based on the data found in the reclassification look-up tables. The current model then distributes these reclassified personnel over six time periods. Following processing, the model appends these results to the REQAST.TBL, sorts the file, and relabels the new file as MODRQAST.TBL which is used in subsequent models.

DATA — All required data for this model are furnished by the REQAST.OUT file.

5.3 CRC MODEL

PURPOSE

The CRC Model is designed to represent the flow of personnel replacements through either a CONUS or OCONUS Replacement Center/Battalion. The model, designed in FORTRAN and SLAM II, depicts the micro-level flow of personnel through the various stations in the replacement facilities over a number of time periods to meet a specific requirement designated by the user. Statistics are generated for both the operation of the replacement facility and the macro-level flow through the system. The first time period of the model is designed to represent the buildup of personnel in the system. Accordingly, there is no output from the system until the first person or groups has completed processing the entire system. Time periods 2 through 18 are designed to represent a steady-state operation. Under these conditions, personnel exit the proces. as soon as the time period begins to represent those personnel in the system at the end of the last time period.

DEPENDENCIES

The model only requires the MODRQAST.OUT file produced from the Reclassification model.

INTERFACES

The model utilizes the output file from the Reclassification model (MODRQAST.OUT) and generates an output file titled CRC (REQUIREMENT FILE NAME).OUT.

PROCESSING

The CRC model is the most intricate of the WARPAM models. The program is initiated through a FORTRAN routine which prompts a second routine to produce an assets file based on the requirements file selected by the user. This asset file also takes into account other user input selections such as transient attrition in building the assets file. This program reads the MODRQAST.TBL, determines the requirement and then builds a file with line entries consisting of single asset types. The assets file consists of as many asset type entries as necessary to sum to the exact requirements for each branch per time period. When this file is completed, the SLAM program is initiated to simulate the flow of personnel through either a CRC or OCONUS replacement unit. The SLAM program terminates processing when either the time limit for the period is reached, there are no entities in the system, or, if a transportation constraint have been invoked, there are no remaining transportation assets. At the completion of the SLAM processing cycle, a set of statistics for the time period is produced and the results of the requirements filled and assets used are stored in an array. The next FORTRAN program prompted is the UPDATE sub-routine which encompasses shifting

unfilled requirements and unused assets to the next time period so that neither is lost through the process. When completed and the last time period has not been reached, the opening FORTRAN routine is prompted and the total cycle begins again.

DATA — All required data for this model are furnished by the MODRQAST.OUT file.

5.4 TRANSPORTATION MODEL

PURPOSE — The Transportation Model is designed to represent the macro-level flow of personnel replacements through the CRC(s) and a specified OCONUS Replacement battalion (RPLBN). The model matches the replacement flow through the CRC and RPLBN to determine if these organizations can meet the requirements for a theater and if the flow is balanced through the two facilities. Statistics are provided regarding the replacement requirement satisfied and the difference in flow capacities of these facilities. The model uses the output files from a CRC model run and a RPLBN model run. The files selected should be based on the same requirement file and number of time periods to produce meaningful results. Currently, the user can select any of the single theater requirement files: Europe (AE1), Korea (AKO), maximum flow (MAX) or either of the CSM II files (CST or CSB).

DEPENDENCIES — The model requires two output files from the CRC model: one file must be for a CRC and the second file from a OCONUS Replacement battalion.

INTERFACES — The model utilizes the output files from the CRC model and produces a single output file which is not utilized by any other WARPAM module.

PROCESSING — The Transportation Model, written in FORTRAN, reads the output files from designated CRC and RPL BN runs and writes portions of these to a file. The result is an output which allows the user to compare the flow through a CRC and a RPL BN. The model also calculates statistics on the system's ability to meet the demand based on the RPL BN flow and on the difference between the CRC and RPL BN flows. To accomplish this the model reads the required data from the two output files and appends these to the MODRQAST.TBL. Statistics are calculated following these reads.

DATA — All required data are furnished by the CRC model output files.

5.5 REPORT GENERATOR

PURPOSE

The WARPAM Report Generator is designed to allow the user easy access to the WARPAM output files while providing a flexible system to develop both standard format and specially designed reports. The preprocessor and models of WARPAM generate output files in the standard UNIX format which are automatically translated to a DOS file when the reports are copied to a PC via the TRAC-FBHN network. The purpose of the Report Generator programs is to translate these DOS (ASCII) files to DBASE III Plus format. Once in DBASE III, the user may chose to use the full reports provide with the WARPAM system or modify these using the DBASE III report menu system.

DEPENDENCIES

Although the report generator is independent of the other UNIX programs, each conversion program has as a minimum a blank DBASE structure shell which must be on the same drive for the conversion programs to operate.

INTERFACES

As the conversion programs translate a UNIX FILE, the location of these files must be identified by path in the programs. The current programs are written to look for these files in the same directory.

PROCESSING

The user or programmer need only enter "DO filename.PRG" to execute the individual conversion routines. These "DO" commands prompt a batch file which reads the UNIX file and converts it to DBASE III format. Once this is accomplished, the user may proceed to the assist system and produce reports using the new file which will be named for the program run with the standard DBASE III extension for a data base--.DBF. To modify the program, the programmer may use the DBASE III modify command processor or any editor as Sidekick to modify the programs. Since these conversion programs are designed to read the WARPAM output file formats, any change to the FORTRAN programs which results in a change in the output file must be accompanied by a change in the appropriate conversion program. The User's Manual should be consulted for specific steps to initiate each program.

DATA

All required data for the report generator are furnished by the specific module or model output files.

ANNEX A

GOVERNMENT STATEMENT OF WORK

1. Class of Analysis: Modification or Development of Army Models

2. Title: Wartime Personnel Assessment Model (WARPAM)

3. Contract: MDA903-88-D-1000, Delivery Order 37

4. Task Background:

Failure to represent the doctrinal force structure's inherent capabilities in the flow of replacements is a serious flaw in the Army Family of Models. In addition to the potential problem of making incorrect force structure and tactical decisions from an overly simplistic representation of the system, the lack of a model linking the various stages of the replacement process precludes detailed analysis of the personnel system's ability to deliver qualified replacements on the Airland Battlefield.

Complicating the modeling problems caused by omitting the doctrinal force structure, the Wartime Replacement System Study (WRSS) estimates 40-50% of all replacements in the first 90 days of warfare will be returns to duty (RTDs) from the medical system. RTDs are grouped into two primary categories; wounded in action (WIAs) and disease non battle injury (DNBIs). The current methodology for estimating RTDs in Army modeling assumes that within each category the distribution of patient conditions is equal and, as a result, RTDs per category have the same probability of recovery. Furthermore, the methodology assumes that remaining physical disabilities never limit the reassignment of the returning soldier. We suspect, however, that MOS may affect the distribution of patient conditions which an injured soldier may experience and that many soldiers will incur serious injuries which will mandate MOS reclassification. Since a unique probability of recovery is associated with most patient conditions, different MOSs would not have the same probability of returning to duty. This phenomenon may change the number of RTDs available in critical MOSs.

Current computer simulations of theater combat define casualties in terms of combat or noncombat. There are no provisions during or after the simulation to consider the correlation between any of the multiple patient classification databases, the expected presentation of casualties resulting from a combat engagement, or the effect the patient reclassifications have on the personnel system's ability to provide the right man to the right job at the right time.

The medical and personnel communities have developed post-processing methods to disaggregate reported casualties from Army combat simulations into categories for treatment analysis (patient classification) and/or replacement

estimation (MOS category/grouping). These methods do not draw upon the vast information contained in the combat simulation to ascertain the patient treatment classifications or MOS fitness for the return to duty patient in the replacement system.

The Concepts Analysis Agency (CAA) uses the historically based Patient Flow Model (PFM) to estimate from the gross quantities of casualties generated by combat simulations, their probable dispositions; RTD, evacuated, died in hospital, and patient length of hospital stay. CAA uses the PFM in conjunction with other models to support the Army Wartime Manpower Planning System (WARMAPS). The Department of the Army is required to submit annually, in conjunction with the Program Objective Memorandum (POM), military manpower data for WARMAPS. This data depicts time-phased personnel requirements, supply, and shortfalls for a specific theater within the Defense Guidance (DG) scenario. It should be apparent that the problems attributable to inaccurately portraying the personnel replacement system impact on decision making at the highest levels in the Department of Defense.

Since RTDs will comprise 40-50% of the total replacements in the early stages of the next war, it is imperative that we analytically estimate the immense effect that the distribution of casualty types, the resultant patient conditions, and the resulting physical profile limitations that RTDs will have on 1) the personnel replacement system's ability to reclassify and process the potentially large numbers of RTDs on a timely and accurate basis; 2) the personnel replacement system's force structure, doctrine, and planning; 3) manpower levels demanded for specific MOSs overtime (WARMAPS); and 4) medical force structure, doctrine, and planning.

5. Task Objective:

The objective of this task is to develop a skeletal computer model which will depict the flows in the U.S. Army's personnel replacement system. This model will provide: (1) a representation of the key doctrinal "links" in the personnel replacement system; (2) the ability to model replacements by grade, MOS, gender, physical profile, and service; (3) a stand alone capability to model the reclassification of RTDs based upon inputs from combat simulations, patient condition classifications, medical treatment system capabilities, results of expert opinion regarding the PULHES profile distribution for the patient conditions, and the personnel system's resultant utilization based upon the reclassification, and; (4) the ability to generate requirements for the logistical system to support replacement operations, including individual equipment items (ie. NBC equipment, individual weapon) and transportation assets.

6. Scope of Work:

After replacements arrive at the CONUS Replacement Centers (CRCs), the model will track replacements (includes new replacements, CONUS and theater RTDs, and administrative RTDs) through the designated theater(s) and through the

personnel system until delivery to the required unit. Statistics on percent fill by time, grade, MOS, the number of combat MOSs RTD but reclassified, and the total number of personnel replacements processed by the system are macro output parameters of the model. Micro level outputs include the number of reclassifications processed, the number of patients per condition serviced by the medical system, and the number of patients with temporary profiles (unable to function in a needed MOS due to temporary PULHES).

The contractor must also address the problems with and potential solutions to the aggregation-deaggregation inherent in using output from one model as inputs (ie. in CEM; ballistic data from AMSAA). These casualties are them inputted into the Casualty Stratification Model (CSM) where we deaggregate and determine casualties by MOS and grade. If this output is used for the medical module outlined in this project, it will again be subject to its aggregated assumptions. The systemic affects of this aggregation-deaggregation-aggregation process must be addressed.

Due to the scope of this model and the monetary limitations of this project, the government will provide the data bases required to run the model to the contractor, only when readily available. If the data is not readily available, the contractor, with possible assistance by the Technical Representative (TR), will use estimates in the establishment of any data base or parameters required to run the model. Data bases or parameters used by the contractor in the model will be documented and provided as part of the contract. Additionally, the government will not furnish any computer software or hardware in the execution of this contract.

The focus of this contractual effort is to develop a skeletal model which over time can be augmented with more accurate data. A plan for future studies or simulations to support this effort is a requirement of the contract. Due to the technical expertise of TRAC-FBHN and the Soldier Support Center personnel, and the availability of computer hardware, the model should (negotiable) be written in ANSI 1978 full language standard FORTRAN.

7. Government Furnished Data:

The government will furnish readily available data to the contractor. If the data is not available, the contractor should identify potential sources for the data, and then use estimates. The project must not be delayed because of data base collection or establishment.

8. Deliverables:

It is anticipated that the work discussed above will require 7-8 months to complete. The contractor will: 1) provide monthly letter-format progress reports to the COTR and TR; 2) provide formal telephonic status reports to the TR at least every two weeks, 3) demonstrate a fully functioning model on the TRAC-FBHN target hardware, and 4) produce a draft final report 7-8 months after the task order award. The report will contain the source code for the developed model,

documentation of the model, assumptions used in parameter estimation, data bases used in the model, suggested uses of the model for pre-processor/post-processor interface with the Family of Army Models, recommendations for data base sources, and recommendations for further study and analysis. A time phased system will be used to allow the TR to review key aspects of the project, rather than assessing the completed package. Accordingly, an in progress review (IPR) will be held on the preliminary design of the model's architecture and methodology; a final IPR will be held that will identify all required linkages to/from other models. The TR will provide comments to the contractor within 30 calendar days of the draft report; the contractor will deliver a final report within 30 calendar days of the TR's comments. The contractor will furnish an oral briefing on the methods and findings to the TRAC-FBHN and others within 30 days of the delivery of the final report.

9. Agency Support:

a. Contracting Officers's Representative (COR) is Mr. Eugene P. Visco, Director, Study Program Management Agency, Office of the Deputy Under Secretary of the ARmy (Operations Research), ATTN: SFUS-SPM, Room 3C567, Pentagon, Washington, DC 20310-0102, telephone (202)697-0026.

b. The Technical Representative for this task is MAJ James R. Thomas, TRADOC Analysis Command - Fort Benjamin Harrison, ATTN: ATRC-B (BLD 401-B), Fort Benjamin Harrison, IN 46216-5000, telephone (317)543-6883.

ANNEX B
TERMS & ABBREVIATIONS

ASSET: Personnel inventory used to satisfy requirements. There are seven classes of assets: TRD-Theater Return-To-Duty, THS-active duty transients, holdees, students and hospital, SEL-Select Reserve, IRR-Initial Ready Reserve, STY-Stand By and IMA, RET-retirees, TRN-skill level one trainees.

AUTOREP: US ARMY PERSCOM shelf requestion system.

Branch: Branch represents the specialties/MOS and grade combinations which have been grouped together in the preprocessor. These branches are then prioritized in the Branch Look-Up Table and given a priority number. The initial version of WARPAM has 67 branch/grade combinations.

CSM II: Soldier Support Center casualty stratification model.

MOBARPRINT: HQDA, ODCSPER system for the projection od skill level one training base output. MOBTNGBS is used interchangeable in WARPAM.

MOBMAN: US ARMY PERSCOM model to project defense guidance level requirements and personnel assets.

Return-to-Duty Rate: This is the percentage of casualties which the user desires to return to duty within the theater. The model will accept either a rate (decimal) or percentage (whole number) ranging from .1% (.001) to 99.99% (.9999). Based on 1989 CAA estimates the recommended rate for current policy is 20%.

Requirements: Personnel requirements in a theater caused by either a shortage of personnel or by casualties. Requirements are derived from other military model outputs and are found in the requirement/assets file.

Requirements/Assets Generator: This module merges the files derived from other military models into a single file, assigns branch priorities, assigns a unique code number, and sorts the file by code number. The output of this module is the REQAST.TBL.

Time Periods: WARPAM time periods are 10 days.

(U) WARTIME PERSONNEL ASSESSMENT MODEL

(WARPAM)

APPLICATION TO PARTIAL MOBILIZATION

(U) EXECUTIVE SUMMARY

(THIS ENTIRE SECTION IS UNCLASSIFIED)

(U) PURPOSE

The world situation at the inception of this study demanded that HQDA, Office of the Deputy Chief of Staff for Personnel (ODCSPER) immediately develop an accurate estimate of the number of CONUS Replacement Centers (CRC) required to support a partial mobilization. The Wartime Personnel Assessment Model (WARPAM) was the sole model available which was designed to assess the wartime capability of the replacement system to provide individual replacements to a theater, but at the time of the study was only in the final stage of development and had not been delivered to the proponent, TRADOC Analysis Command-Ft Benjamin Harrison. To meet the study specifications within the constrained time period, the Army determined that the WARPAM developer, SAIC, should conduct the study utilizing the final test version of the model.

(U) STUDY OBJECTIVE

The objective of this task was to utilize WARPAM under a partial mobilization scenario to develop data required by the ODCSPER regarding: average individual replacement flow through a CRC with planned configurations, the number of CRC required to process estimated requirements, and the capability of the CONUS base to provide timely personnel replacements. Due to the limited time period of the project, variations of model parameters were limited to those necessary to develop the data required by the ODCSPER. As WARPAM had not been validated by the US Army proponent, TRAC-FBHN, work under this task order was also considered an accreditation of the model for the specific parameters utilized and model outputs and reports were reviewed and approved by the TRAC-FBHN project advisor, Dr Klopp, prior to release. The specific study objectives were to determine:

CRC, given the processing stations and corresponding processing times.

- The number of CRC required to process the aggregate number of replacements per day as prescribed by the ODCSPER.

- Statistical information regarding the CRC processing stations to include, as a minimum, the utilization rates and backlogs at each station.

- Branch level data for officers, warrant officers and enlisted personnel (branch being defined basically as CMF with variations determined by the ODCSPER) depicting the capability of the CONUS individual replacement base to support a partial mobilization scenario.

(U) TECHNICAL APPROACH

In general terms, the study was performed in three phases: data collection, analysis, and review. Documentation of modeling and data collection efforts was accomplished throughout the study. During the first phase, data were compiled regarding the activities comprising the CRC, activity processing times, planned TDA structures, processing schedules to include administrative days or activities, and any constraints placed on billeting and air transportation. Initially, information was derived from the newly published draft CRC handbook and later modified to correspond to the structure and schedules of the three planned CRC as these were established. The constrained study period precluded any assessment of the capability of the CONUS base to sustain replacements at the branch (CMF) level under this partial mobilization scenario as a personnel assets file could not be compiled from available Army data. Data collection, in fact, continued through most of the analysis phase as new information materialized from the evolving CRC organizations.

During the analysis phase, WARPAM was modified to route personnel by branch through the CRC specified in the Army plan and to accept a requirements file specifically developed for the scenario. A total of eight computer simulations were conducted which included the initial base case and a series of modified runs which increased personnel flow to CRC capacities. The last two simulations modeled revised Army planning data which enabled the system to achieve the required output by time period and in the aggregate. Additional excursions to investigate alternative options such as commencing full scale replacement operations prior to peak requirement periods or introducing additionally CRC organizations were also conducted to provide the ODCSPER with a full breadth of viable alternatives. Lastly, the results of alternative strategies were compared against a range of requirements to assess their capability against varying combat scenario.

In the final review phase, data from the eight simulations was graphically displayed comparing essential factors necessary to assess the alternate strategies developed to increase flow and those of evolving Army policy. This review included analysis of such critical factors as the differential in processing times and processing queue times for platoon or group versus individual movement, the effects of Army policy concerning air transportation planning factors, programmed daily input to the CRC, and increases in the capacity of limiting activities of specific CRC.

(U) FINDINGS

The following findings summarize the data furnished to ODCSPER:

- Replacement flow estimates at the start of the study were well within the capacities of the planned CRC, but failed to achieve either peak or cumulative requirements.
- Initial estimates of the capacities of the planned CRC approached both peak and cumulative replacement requirements.
- The total replacement flow could be expanded to the capacity of the CRC by increasing planned daily input and either augmenting the number of platoons or enlarging the size of the platoons.
- Processing individuals or groups smaller than the planned platoons reduced total processing times.
- Revised Army planning figures with an increased number of processing companies and expanded CRC capacities can achieve initially estimated replacement requirements.
- To achieve additional replacement flow, either the process must be initiated prior to the peak requirement periods or additional CRC must be opened in sufficient time to become fully operational by the required time.